Morphological analysis of the fetal electrocardiogram during pregnancy

G. Pardi, A.M. Marconi, E. Ferrazzi

First Institute of Obstetrics and Gynecology,
Perinatal Unit,
University of Milano, Italy

Fetal electrocardiogram (FECG) can be recorded during pregnancy from electrodes placed on the maternal abdomen: in this way the fetal signal is masked by the maternal ECG and by a background noise, with poor signal-to-noise ratio. In order to analyse all the FECG components it is necessary to process the signal with electronic techniques: the system used to detect and enhance the fetal signal has been previously described (1). The cardiac currents do not leave the fetus through fixed pathways: the intensity and direction of currents flowing in the mother's body vary throughout the cardiac cycle. The topographical relationships between the fetal heart and the recording electrodes are not known. In these conditions the only information we can deduce from the tracings regards the heart rate and rhythm and the duration of the electrocardiographic waves; whereas the shape, amplitude and polarity of the electrical signal do not provide any useful information. In the human fetus informations on the size and weight of the heart can be obtained calculating the intraventricular conduction time (QRS duration): in normal pregnancies there is a progressive increase of the QRS duration that parallels the gain in weight of the fetal heart throughout gestation (1). In pregnancies complicated by severe Rhesus immunization, there is a constant and early involvement of the fetal heart in terms of myocardial hypertrophy and/or cardiac enlargement: in these cases, QRS duration values are largely higher than normal values, reflecting the increase of the cardiac mass (2). Similarly, the lower heart weight in cases of fetal growth retardation (FGR) might be reflected in QRS duration decrease.

Fetal ECG was successfully recorded from 68 pregnant women with suspected fetal growth retardation on the basis of ultrasonic findings. Data obtained from the analysis of the fetal ECG were not known to the medical staff and did not influence the clinical management. At birth, fetal weight was evaluated according to the intrauterine growth italian standards : 14 fetuses were normal and 54 growth retarded (23 between the 10th and the 2nd centile and 31 below the 2nd centile). All but one of the 14 normal fetuses showed normal values; 10 out of the 54 growth retarded fetuses showed normal values while the remaining 44 exhibited QRS duration values greater than 2SD below the mean for their gestational age (29 between -2SD and -4SD and 15 below -4SD).

Our results would indicate, in cases of suspected FGR, a positive predictive value of the QRS duration of 98% and a negative predictive value of

J.Perinat.Med. 12(1984)

57%. Even if these percentages should be carefully handed, since our series is a selected one and numbers are small, the QRS duration seems to be a good indicator of FGR.

The QRS duration seems to be also a reliable prognostic factor of perinatal outcome. Normal values are a reassuring factor: abnormal cardiotocographic records were observed only in 2 out of 23 cases and no low Apgar scores or perinatal deaths occurred; particularly, growth retarded fetuses with normal QRS values had a good perinatal outcome: in these cases a good circulatory adaptation to the factors inducing FGR may have prevented the decrease of the fetal heart mass. On the contrary, QRS values below the confidence limits represent a bad prognostic factor: perinatal distress increases progressively with the reduction of QRS duration. QRS values below 4SD resulted to be consistently associated with abnormal cardiotocographic records (6/13), low Apgar scores (5/15) and perinatal deaths (3/15).

The expense and expertise involved in recording and analysing the fetal ECG precludes its widespread use, unless more semplicity of the equipments is achieved in the future; furthermore, between the 28th and the 32nd week, successfull records can be obtained only in 60% of the cases (1). However, QRS duration serial measurements may represent a sensitive method for the identification of FGR: moreover, this parameter may be a further indicator of fetal state, contributing to discriminate growth retarded fetuses with poor perinatal prognosis, hence allowing a better timing of delivery.

Bibliography

(1) BRAMBATI, B., G. PARDI: The intraventricular conduction time of fetal heart in uncomplicated pregnancies. Brit. J. Obst. Gynaec. 87 (1980) 941

(2) BRAMBATI, B., G. PARDI: The intraventricular conduction time of fetal heart in pregnancies complicated by Rh Haemolytic Disease. Brit. J. Obst. Gynaec. 88 (1981) 1233